BELL TELEPHONE QUARTERLY

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JANUARY, 1931

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AMERICAN TELEPHONE & TELEGRAPH CO.
NEW YORK

INSTRUCTING A STUDENT OPERATOR AT A PRACTICE SWITCHBOARD.
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BELL TELEPHONE QUARTERLY

A Medium of Suggestion and a Record of Progress

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What the Electrical Communication Industries Expect of the Technical Schools

Address by Bancroft Gherardi, Vice President and Chief Engineer of the American Telephone and Telegraph Company, at Lehigh University, October 16, 1930.

AS a part of the ceremonies of the dedication of the James Ward Packard Laboratory of Electrical and Mechanical Engineering, I have been asked to speak on "What the Electrical Communication Industries Expect of the Technical Schools." At the outset, I must admit that I cannot undertake to speak for the whole electrical communication industry of these United States; I can only speak for that considerable part of it known as the Bell Telephone System. Even in this narrower capacity, I cannot say that there would not be some who might differ from me in their ideas on this question. It is a question in which I am greatly interested and to which I have given much thought. What I say is based upon over thirty-five years of experience and observation in the Bell System, and I feel confident that my views do not differ in any essential respect from those of the great majority of my associates.

The Bell System has in round figures 400,000 employees. The administration of this number of people engaged in a business which extends throughout the whole of this country, which is growing rapidly, and which is based upon a complex and rapidly developing art, necessarily requires much administrative ability, a large and skilled administrative personnel, and many departments whose work demands a knowledge of scientific and technical questions not only by the supervisors but by practically every member of the department.

A recent survey of the Bell Telephone System showed that on the first day of this year there were over 14,000 college

graduates in the System. College graduates constitute a most important part of the supervisory personnel, and about one-third of all the supervisory positions in the Bell System are filled by men who have had a college education. We were among the earliest of the business organizations to recognize the value and the opportunities of the college man in industry. Almost from the invention of the telephone, it has been a definite part of our program to hire a number of college men each year.

Of the college graduates in the Bell System, about 55 per cent are graduates of scientific or technical courses; about 35 per cent of courses in arts and science; and about 10 per cent come from business courses. Enough facts have been given to show the dependence which the Bell System has placed, in the building up of its supervisory and technical forces, upon the graduates of our colleges and universities, and especially upon the graduates of our scientific and technical schools.

We have been employing, on the average, during the last few years about 1,500 college graduates each year, and there is every reason to believe that this is a fair measure of our future requirements. In making our studies of our needs for college men, we are careful not to make our estimates so large that we will be unable to give to each man opportunities for advancement commensurate with his abilities. We also make full allowance for the developing of men from our non-college forces, and many able men in the supervisory and technical forces of the Bell System have come from this source. For the rest, we must look to the colleges. In addition we must go to the colleges for a large part of the personnel of such departments as those dealing with engineering and research.

Perhaps no industrial organization has a greater diversity in the scope of its work than the Bell System. The Western Electric Company, the manufacturing department of the Bell System, employs over 70,000 people, and at the present time has about 2,700 college graduates. The Bell Telephone Lab-

oratories, the largest industrial laboratory in the world, employs over 1,200 college graduates; the remainder of our college graduates, over 10,000 in number, are engaged chiefly in the supervision of operations and the carrying on of engineering and technical work pertaining to the telephone business. In order that in this paper I shall not try to talk about too many things at the same time, my remarks from now on will be confined to a consideration of the requirements of positions in the engineering and operating departments of the System, although many of my comments might apply equally well to our laboratories and manufacturing department.

Perhaps it would not be out of place at this point for me to make some reference to the kind of men that we would like to get from the colleges and technical schools, for the output of the colleges is a product of at least two factors—the characteristics of the men themselves, and the influence which their education has had upon their knowledge, judgment and character. As the technical schools are in general responsible not only for the courses of training which they give to their students but for the selection of the students themselves, it would perhaps not be amiss for me to outline briefly what seem to us to be the principal characteristics of a good man of the type which we are now considering. Perhaps such an analysis might be of some help in the selection of the men who are to receive technical training, and perhaps it might have some influence upon the kind of training to be given to them.

What we want are men who can recognize the problems with which they are confronted; study the problems; determine the appropriate action; and then take such action in the right way. For men in administrative and general engineering departments, these seem to me to be the essential requirements, and to perform them adequately there are a limited number of characteristics necessary. There are others which are desirable, but those which I shall enumerate here seem to me to be essential.

Understanding of the problem needs perception. Questions do not ordinarily come to those in responsible positions in concrete form; such persons live in the midst of events and have to see accurately what the situation is. There can be but little perception without broad knowledge of the business, as things must be seen in proper relation to each other and to the business as a whole. There must be imagination, intelligence, judgment, intellectual honesty, and high aims.

The study of the problem and the determination of the action to be taken after perceiving that some action is required or is desirable, requires, in addition to the characteristics already named, courage or the will to do; requires an active type of courage—the willingness, even the eagerness, to face difficulties, both difficulties of a physical nature and opposition from others. The determination of action, which often involves personnel questions, requires a sense of justice.

The effective carrying out of action when decided upon involves an additional characteristic—skill in persuading and in meeting difficulties, for there is often met inertia and opposition in the processes of execution. These must be overcome and the many subordinate questions which arise in a large undertaking must be disposed of satisfactorily.

To the above, I would add only a few additional characteristics: good health; a sympathetic understanding of people and of the world at large; and an ability to carry on several projects simultaneously without becoming overwhelmed or confused by varied activities.

Some may be surprised that I have made no specific mention of tact. It is admittedly helpful in getting things done and in making life pleasant for all concerned; it is a desirable characteristic for men in administrative work; it is perhaps, at least in some of its aspects, included in "Skill in Persuading and in Meeting Difficulties." Probably men wholly lacking in tact will not be completely successful. However, I think we all know enough successful men who are not markedly tactful to

suggest the possibility of overrating tact as an essential characteristic. I believe that co-operation and good morale may be maintained by other means, such as enthusiasm, sincerity of purpose, and by just and fair dealing. An over-emphasis on tact may result in the selection of colorless individuals and those lacking force.

I have not specifically mentioned skill in the judgment of people. This is essential, but in general I believe it goes with the other characteristics outlined, for good all-round men instinctively recognize one another. To be able to select good men, train them and give them opportunities for advancement, are of course essentials.

In speaking of the educational course itself, I shall confine myself to discussion with reference to preparing the student, not for his general responsibilities to society, but with reference to the special qualifications needed in his professional work. This is not because I underrate the importance of having a man prepared to play his part in the general social structure, but to undertake to consider that aspect of education would carry me far beyond the scope of the subject on which I have been asked to speak. Even the aspect of the subject to which I have limited myself is so broad that it is impossible for me to treat of it here comprehensively. I shall only undertake to bring out a few ideas which my experience has indicated as worthy of consideration.

Telephone engineering is one of the specialties into which engineering has been differentiated, and while ordinarily considered a subdivision of electrical engineering, in fact it invades many of the other fields of engineering, notably mechanical engineering. I do not feel that the school training of a man for communication engineering should be essentially different from that given to electrical and mechanical engineers in general. The communication engineer is, after all, confronted by problems which are underlain by the common basis of these branches of engineering; he deals with the same materials and

the same physical laws; and his problem, as in other branches of mechanical and electrical engineering, is to accomplish the most satisfactory results in the most economical manner, and so that the product of his work will meet not only the conditions of today but those of the future.

In the relatively short time available for the professional training of the student, it is not possible to teach everything in science and engineering which might be useful in his profession. It seems therefore that the important thing is that the engineering student should have discipline in the methods of solving engineering problems and a general foundation in mathematics, physics and materials which will enable him to solve the special problems that come before him by getting the facts in that case and then interpreting these facts and reasoning from them correctly. Train the student on the necessity of getting his facts and teach him the best methods of getting engineering facts, and train him on interpreting engineering data and in reasoning therefrom. I am not suggesting that his education should teach him the facts beyond the fundamental ones.

All important communication systems today, except those which are essentially transportation problems, are basically electrical. Therefore, in electricity, the student's work should be carried further than in other branches of physics, and he should have a thorough working knowledge of both direct and alternating currents. In addition to giving this knowledge in abstract form, it should be taught in some of its principal applications. Laboratory experimental work is valuable but should, it seems to me, be carried on primarily as illustrating fundamental laws and so as to give the student the manual dexterity needed in handling electrical instruments. The time devoted to this work may be divided between the different branches of electrical engineering, and certain fundamental problems with reference to the telephone and telegraph should not be excluded.

One of my strongest convictions is that unusual effort may well be made to teach every engineering student to speak and to write a report or letter in clear convincing English, setting forth the facts and arguments and conclusions pertaining to the question before him. It is of the greatest importance to an engineer that he shall be able to state in correct and logical form the problem before him, and to enforce his conclusions with arguments which shall be convincing. Such training as this is not merely one in literature, composition or rhetoric, for to present such a report the problem must have been mastered, and clear thinking must precede clear speaking or writing. It has always seemed to me that a knowledge of at least one foreign language is desirable, perhaps more so than ever now that the export business and foreign activities of this country have become so great.

I do not know how much it is possible within the scope of technical education to emphasize the importance of arriving at the most economical solution of a given problem. Correct engineering is the determination of the most economical way of arriving at a desired result. It is not sufficient to find a way to accomplish a result; it should be the most desirable way. I can appreciate the difficulties of emphasizing this point of view in a college education, but whatever can be done along these lines will be helpful.

I do not think that it is possible to over-emphasize the importance of accuracy. I have sometimes noticed that beginners in engineering seem to feel that arithmetical errors are of trivial importance as compared with the use of incorrect mental processes. Without wishing to condone the use of incorrect mental processes, I should like to point out that, as far as practical results are concerned, errors due to carelessness are as serious as those due to incorrect mental processes; in fact, they are often even more troublesome to deal with, because errors of logic can be detected by a competent chief engineer in a comparatively brief examination of the subject, whereas

errors of computation and similar errors can be found only by a complete re-check of the work.

In presenting my ideas to you on this matter, I have tried not to be dogmatic. I recognize that it is for the educators to determine how results in education shall be accomplished, while, on the other hand, it is the duty as well as the privilege of those in industry to outline what they need. In some ways the problem is analogous to the relation between the operating departments of the Bell System and its manufacturing company. The operating departments undertake to tell the manufacturing company and the laboratories what they want, but not how it shall be manufactured; it is the function of the manufacturing department to determine how a given device or mechanism shall be manufactured in order to produce the desired result. Education is in many ways a more complex operation, because manufacturers use uniform standardized materials, while the educational process is not applied to uniform materials but to human beings of infinitely varying characteristics. While this greatly complicates the problem of the educator as compared with that of the manufacturer, it does not in my opinion greatly change the relationship which should exist between the educators and the employers who subsequently will hire those who have been educated.

In accepting the pleasant task of speaking to you as a representative of the communication industries and in trying to outline what we "expect" of the colleges, I would not wish you to think that I feel that in the past our colleges and technical schools have not met the needs of the Bell System. We are deeply appreciative of the contributions which the graduates of Lehigh University and of the many other colleges represented in our organization have made to our success. They will be important contributors to further progress in the years to come. Nothing that I have said should be interpreted as criticism of these men or of the institutions in which they acquired their academic training. On the contrary, I am ready to maintain

at any time that these men have been essential to the Bell System and that the training which they received during their years of academic study was essential to the contributions which they have made. If what I have said is helpful to the educator in arriving at a more definite understanding of what the communication industries expect of the technical schools, I am grateful to have had the opportunity to present this paper today.

The Training of Telephone Operators

THE important part played by the operator in furnishing telephone service is a matter of common knowledge. As the industry has grown, her work has evolved from a simple occupation to one of such scope as to require careful training; and the Bell System has attempted to meet this training requirement. This has involved the development of an extensive educational system within the telephone business, adapting the science of vocational training to the needs of one of the largest and most essential classes of women workers.

The extent of this training problem was pointed out by Mr. K. W. Waterson in his article, "Change from Manual to Dial Operation," which appeared in a recent issue of the BELL TELEPHONE QUARTERLY. In this article it was shown that in 1920, at the time conversion to the dial system started, there were 128,000 operators in the Bell System and that in July, 1930 with the System 28 per cent on a dial basis, there were 160,000 operators. It was stated, moreover, that by 1940, when all proposed dial conversions will have been completed, there will be 180,000 operators.

It is necessary to employ many thousands of new operators each year to meet the demands of this increasing force, and the Bell companies exercise great care in conducting the examination of applicants for these positions. In large cities, at least two out of three applicants for operators' work are rejected because they fail to meet the essential qualifications.

Each applicant for operators' work is interviewed by an employment representative of the telephone company, and if this interview is satisfactory, she also is examined by a physician. This interview and physical examination, which reveal whether the applicant possesses the essential qualifications, are conducted with the objects of protecting and furthering the interests of sustained, dependable telephone service, the interests of the applicants themselves, and those of the other employees with whom accepted applicants will work and be

associated. Among the more important items considered are intelligence, health, sight, hearing, voice, size, temperament, character, appearance, and previous record.

An applicant accepted for employment is assigned to a training department which has the function of training her in the work for which she was engaged, and she becomes a paid employee on the day on which her training starts. Long ago, telephone operating apprentices, as well as those in other occupations, were trained by being placed on the actual job, and acquired skill as best they could through observation, contact with skilled workers and the performing of such tasks as came within the scope of their ability. This plan had the serious disadvantage that training became interwoven with productive operation to an extent which was detrimental to both. The recognition of this disadvantage led to the establishment of organized vocational training in trade schools and also within important industries. In this matter of providing exclusive training facilities for its operating employees, the Bell System can take pride in a record which extends back twenty-five years. During that time well organized operators' training departments have been established and operated in all of the large cities served by the Bell System.

The training department provides for the student a training course which prepares her to start handling the ordinary work of a regular operator in a central office in a dependable manner. This training is given by instructors who, first of all, are experts in the operating work in which training is to be given and who also have the ability and training to teach others to perform this work.

In the training department the student operator is instructed in classrooms in the methods of performing her work and also receives practice in the actual handling of this work. This practice operating is considered the most important part of the training and is given on special switchboards by means of simulated calls under the full control of the instructors. These

calls are varied according to the requirements of the individual students, but in every case a student handles many hundreds of practice calls before she ever handles a regular service call in a central office.

Intensive drills are given to the students in certain features of their work, such as locating lines on the switchboard, the use of phrases, and the understanding of speech as heard over the telephone by an operator. The drills in the use of phrases and in understanding are fundamental to an operator's work, affecting, as they do, the transmitting and receiving of the orders, requests, and acknowledgments which determine and control the service rendered by her. Particular care is taken to impart such training as will result in clear enunciation and accurate hearing; and an ingenious arrangement has recently been produced for developing the hearing of students. By means of this device, the transmission on practice calls is gradually reduced during the training course, until, at the end of the course, the students are receiving orders which are more difficult to hear than any they will ordinarily receive when handling actual calls.

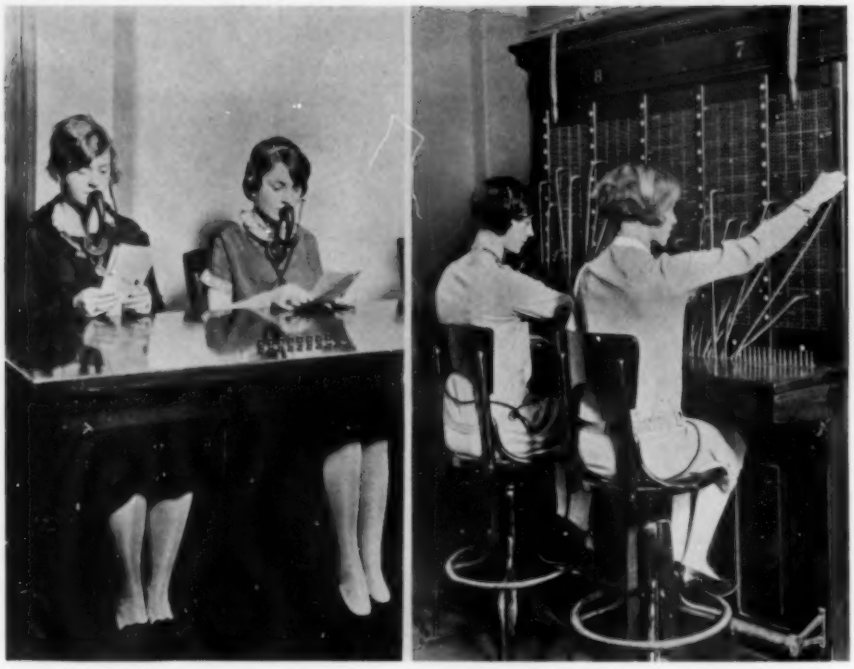
Of all the training activities, the one which the students like best is operating on the practice switchboard. This is quite natural, since this activity is essentially the same as the job for which they applied to the telephone company. The instructors realize the advantage of satisfying this interest on the part of the students, and an attempt is made to give them as much of this practice operating as the general progress of their training will permit. At the very beginning of the training course, one of the first things the student does is to go to a practice switchboard and establish a few connections under the direction of an instructor. This lays a foundation of interest and satisfaction for the training which is to follow.

In order to adjust the training of students accurately to the work they will perform, periodical analyses of the work of operators are made in the central offices in each city. This adjustment of the training to the job—a basic requirement of

Student operators are shown a feature of telephone operation with a demonstration switchboard.

Student operators listen in on numbers received at a working switchboard and write them down.

STEPS IN THE TRAINING OF TELEPHONE OPERATORS.



The girls at the left pass numbers to the student operators at the right who are finding the lines on a practice switchboard.

Student operators under instructors at a practice switchboard handle calls made by the girls at the right.

STEPS IN THE TRAINING OF TELEPHONE OPERATORS.

effective vocational training—results in concentrating the training in each city on those operations which actually make up an operator's ordinary job in that city. Only a relatively small proportion of the wide range of operations embraced by any important class of operating occur frequently enough to be included in the ordinary work of an operator, and these conditions vary as between cities. Hence the advantage of this analysis is apparent.

Another interesting training analysis is one which is made, at intervals, of the work of students immediately after they start to operate in the central office. This reveals those features of the work with which the students are encountering the most difficulty and thus forms the basis for readjustments in the training. Important advances in training have resulted from this sampling process.

When the student is capable of handling a moderate quantity of the ordinary work of an operator in a dependable manner, she is sent to a central office. There she receives such additional instructions as she needs to prepare her to take up her work. These additional instructions have to do with arrangements peculiar to that particular central office or conditions which are of such infrequent occurrence that they are not included in the training department course. She is given all the assistance and instructions she needs, but she is also given real work to do, since the latter is an essential requirement at that stage of her development as an operator. Soon she is performing a regular operator's work, although, of course, in limited quantity. Her remaining progress is largely a matter of acquiring experience under the direction of expert supervisors.

The progress of the student through her training course and then on through the central office to become an operator is gradual and uniform. Every training step has two objectives, namely, training in the feature involved, and also preparing the student to take up the steps which follow. This is important

to the student because it renders easier her task of acquiring skill in her new work, and it is of advantage to the telephone user because the student has acquired reasonable proficiency before she handles his calls.

Throughout the training course and after the beginner goes to the central office, careful attention is given to making the training and the work as pleasant and interesting to her as possible. The training itself is planned and administered with this in mind, and the associations of the student with the supervising and instructing employees and with her associates are kept on a cordial and friendly basis. An attempt is made, in particular, to let the student know of the interest which the Company takes in her welfare and progress, and also to give her the opportunity to observe the progress she is making.

Sustained attention is devoted to keeping operators' training abreast of approved vocational training development and to producing such distinctive new arrangements as the conditions of telephone operation require. Training studies and experiments are continually being made with these ends in view.

The training imparted to the student operator not only serves to prepare her to perform skillfully the important work of telephone operating, but also forms a sound basis for advancement to higher positions. This is attested by an imposing group of women employees, who started by taking this same student training course and who, today, are occupying positions of importance and responsibility.

The task of administering this training is full of live, human interest and appeals to the imagination. The training organization, in performing its work, has the satisfaction of knowing that it is not only contributing to the furnishing of an essential service, but that it is helping thousands of girls to learn something useful and profitable.

The training described in this article is local operators' training, which differs in some respects from toll operators' training.

H. C. LaChance.

Moving the Indianapolis Telephone Building

CONSIDERED from the viewpoint of popular interest, the moving of the Indiana Bell Telephone Company's main building in Indianapolis, housing the administration and downtown business offices and toll equipment, was perhaps one of the outstanding engineering projects of the year. This 11,000-ton building of steel-frame and brick construction, eight stories high, covering an area of 100 feet x 135 feet was moved and turned from its original position at the front corner of the lot facing Meridian Street to a new location at the rear of the property fronting on New York Street, as indicated in Figure 1.

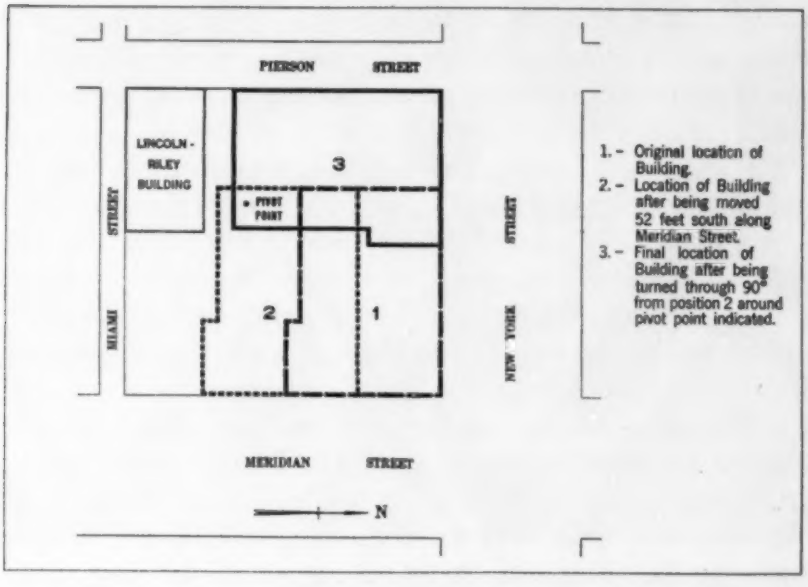

PIERSON STREET
LINCOLN - RILEY BUILDING
3
PIVOT POINT
2
1
MIAMI STREET
NEW YORK STREET
MERIDIAN STREET
N
1. - Original location of Building.
2. - Location of Building after being moved 52 feet south along Meridian Street.
3. - Final location of Building after being turned through 90° from position 2 around pivot point indicated.

FIGURE 1. Plot Plan.

It was determined after a study of several possible schemes that by first moving the structure in a straight line 52 feet south it would then be practicable in the space available to rotate it through an angle of 90° into its final location. In effect, the general plan of carrying out this operation was, after excavating the site, to strip the building down to the steel skeleton below grade, cut it loose at the foundations and load it onto rollers, the building then being pushed and pulled in the required directions using for a road-bed a system of tracks laid generally railroad fashion on a concrete mat.

The structure, except for the basement, continued to be fully occupied and business was conducted with the public and employees coming and going as usual and with the normal operation of all house services and telephone equipment. For example, gas, water, sewer and steam heat services were continuously maintained through flexible hose connections at the basement ceiling level and the electric service through temporary overhead leads from a pole, all as shown in Figure 2. Elevator service, which normally included travel to the basement, was continued by stopping the cars at the first floor with proper safety apparatus installed on the steel framework under the shaft. To avoid any interruption to the service, the telephone wires where they left the building were lengthened by splicing in place temporarily seven large armored submarine-type cables —five for toll circuits and two for trunks to local offices—with 200 feet of slack. As a point of interest, through these cables a telephone conversation between a young man in Australia and his father who was ill in an Indianapolis hospital took place while the building move was under way.

The objective in moving the structure, erected in 1906, was to clear the front portion of the lot to provide space for the erection of a new administration and equipment building required to keep pace with the continuing telephone growth in Indianapolis. Meridian Street, along which the new structure is to be erected, is one of the principal thoroughfares of

FIGURE 2. Eighteen men with jacks push 8-story, 11,000 ton building. This picture shows the start of the straight move south.

FIGURE 3. A close-up view of jack operation, I-beam construction, rollers and rails.

the city and by relocating the old building it was possible to realize fully the inherent value of the property, to allow development of the new building along the most desirable lines and to secure the full service life from the existing buildings and telephone equipment representing in all an investment of close to $4,000,000.

Preliminary Work

To prepare for the move, a considerable amount of preliminary work was necessary in the form of wrecking relatively small buildings on the property, driving steel sheet piling to hold up the embankments along the streets and underpinning the adjacent Lincoln-Riley building in which is located local telephone equipment. Also, to maintain connection between the main entrance and the sidewalk, a movable steel and concrete bridge, shown in Figures 4 to 10, had to be constructed. One end rested on the floor of the building vestibule entrance and the other was supported on rollers near the sidewalk. Arrangements were provided also for continuing in service the fire escape at the rear.

Temporary provision was made on the first floor for the mechanical and electrical house service equipment. The heating boilers which were used as a reserve for outside central heating service and which were located in a sub-basement occupying a small area at one corner of the building were removed and the lower level was built up solidly to the elevation of the rest of the basement. Provision for these boilers did not have to be made in the new location as this reserve will be cared for in the new building. Following this the floor and the walls, as well as the fireproofing on the columns in the basement, were removed. With this space cleared out, except for piping on the ceiling, the entire area over which the building was to move was excavated to a depth of about 21 inches below the level of the basement, and foundation footings were placed in the new locations.

Trackage and Bracing for Building

The next step was to provide for the system of trackage. For this a reinforced concrete mat, generally six inches thick, was placed over the entire ground area upon which the building would travel and laid level with the top of the footings. While the underlying gravel provided very firm bearing conditions, the mat furnished a rigid flat base for distributing the concentrated loads during the moving operation and insured a level surface for laying the tracks and rolling the building. On top of the concrete mat 6-inch x 8-inch timbers were laid similar to railroad ties to act as a cushion and to help distribute the weight. They permitted any slight unevenness in the thickness of the mat or in the height of the rails to be taken up as the building loads rolled along. Across the timbers railroad rails, used ones obtained for the occasion, were laid close together generally without spiking, as there was no tendency for the rails to move under the heavy loading and slow steady movement. Both the timber and the track arrangements can be seen in Figure 15.

As means for lifting and supporting the weight of the building, brackets formed of I-beams were riveted to the 59 columns and under these brackets were placed two layers of heavy steel beams extending in two directions. Some of this bracing can be seen in Figures 2 and 3. All of these steel members were rigidly fastened and tied together to resist any possible twisting strains. The use of wood for structural bracing was avoided for fire protection and other practical reasons.

With the mat and trackage in place and the steel supports and bracing fastened to the columns, the building was ready to be lifted the ¼ inch required to permit of sliding the rollers and steel bearing plates or shoes under the supporting beams, all of which are illustrated in Figure 3. The longer columns which had extended to lower levels because of the sub-basement boiler room previously referred to, were burned off at a point

FIGURE 4. As the building appeared on October 14 ready for the move to start.

FIGURE 5. On October 18 the structure had reached the end of the straight move.

FIGURE 6. October 25 showing curved walk in place. The building turn has been started.

FIGURE 7. By October 28 the turn of the building was becoming quite apparent.

FIGURE 8. Two days later on October 30 shows one-third of the turn completed.

FIGURE 9. On November 1 the structure had moved around to the half-way point.

THE FIRST STAGES OF THE MOVING OPERATIONS.

FIGURE 10. November 4. The front face of the building has now disappeared from view.

FIGURE 11. By November 6 only one-quarter of the right-angle turn was left.

FIGURE 12. November 8. The rear of the building begins to show in this picture.

FIGURE 13. November 11. Next to last day and only a few feet to go.

FIGURE 14. On the afternoon of November 12 the building move had been completed.

FIGURE 15. Pulling cables, trackage and arrangements for public to view operations.

THE SECOND HALF OF THE TURNING MOVEMENT.

above the tracks. The rollers were 3-inch solid steel shafting 30 inches long. The bearing shoes were made up of four short lengths of railroad track laid between two ¾ inch steel plates about 2 feet x 4 feet in size, the bottom plate being bent upward at the ends to facilitate feeding in the rollers.

The building was raised by 100-ton ratchet screw jacks placed under the upper layer of beams. It was not practicable to lift all of the columns in one operation and they were accordingly handled in groups of four to six at a time. The rolling equipment was placed under the lower layer of beams and the cast iron bases supporting the bottom of the columns were slid out from under them. The jacks were then released transferring the loads to the rollers. This operation was repeated until the entire building had been freed and placed on rollers.

It might be interesting to note here how the column loads, which amounted for the largest ones to 250 tons and which were supported on four sets of shoes and rollers, were distributed over the tracks. Each of these sets carried one-quarter of this total load or about 64 tons. This was spread over eight rollers, each of which rested on an average of four rails resulting in a pressure on a rail of about two tons under each roller.

Moving Operations

In pushing the building on the first straight move eighteen jacks, each handled by one man, were used as shown in Figures 2 and 3. The jacks, although rated at 100-tons capacity, were operated to exert a force of only about 10 tons each or a total of approximately 180 tons. This was equal to a little over 1½ percent of the total weight of the structure. The relatively large number of jacks was adopted with the view of distributing the forces evenly along the length of the building and of balancing the pressure with respect to the steel bracing on either side of the columns.

The jacks were braced against timbers clamped to the tracks

and projecting over to the steel sheet piling and retaining wall at the street as indicated in Figure 2. Reblocking was necessary for every twelve inches the building moved, this being the limit of travel of the jack screw. As an idea of the speed of operation, at the sound of a whistle the jack handles were moved back and forth six times through an arc of 90°, this taking about half a minute. The men rested about another half minute and then the whole operation was repeated. For these six strokes the jack screws and the building moved ⅜ inch. By counting the number of strokes and by judging the amount of resistance offered in operating the jacks, the men were able to determine with a fair degree of accuracy the amount of pressure being applied and were able to maintain a very even distribution of the pushing forces. As a safety factor the bracing between the columns provided insurance against any possible twisting effect from unbalanced forces, and also frequent check-ups were carefully made on the alignment of the structure and supports as an additional precaution. The distance of 52 feet for the first straight move was covered in four days, October 14 to 18, this being illustrated in Figures 4 and 5.

At this stage of the operation, a steel and concrete curved temporary walk shown in Figures 6 to 14 was constructed to maintain sidewalk connection with the bridge entrance during the turning operation.

As soon as the building had been rolled to its farthest point south, the work of raising it again to change the position of the shoes and rollers was started. This step, which was similar to the first one of placing this equipment, was completed in four days and then the building was ready for the turn into its final position. The procedure was to rotate the structure around a pivot point near the rear inside corner of the building which is indicated in Figure 1. The engineering features involving the layout of the tracks and ties as well as the guiding lines, and establishment of the pivot point formed a very important part

of the project. The pivot point had to be so located that the building might be rotated about it exactly into its final position. Lines radiating from this point were painted on the rails as an aid in setting the shoes and rollers which were required to be parallel with them. Some of these lines can be seen in Figure 15. Other marks were placed on the rails to indicate at all times the direction in which the structure was to travel. With the radiating lines determining the position of the rollers and with the requirement of having the rollers pass over the rails at an angle of not less than 45°, it was possible by anticipating these conditions to arrange the track layout in advance so that it would be unnecessary to change any of the rails after they were once laid.

The horizontal force for the principal part of the turning movement was provided by ten jacks pushing on the south side of the building and two sets of tackle blocks pulling on the north side using stranded steel cables operated from separate drums on a stationary steam engine. The pulling arrangements are shown in Figure 15. The strain required on each single line to keep it taut, with the jacks also pushing, was not over three tons. This six-ton pull for the two lines was multiplied through the six-sheave tackle blocks to about 72 tons total force. The ten jacks pushing on the opposite side of the building developed in the order of twice this force, making a total of something over 200 tons. These force agencies easily moved the building with margin to spare and permitted a more satisfactory rate of speed during the turning than could have been obtained by the use of jacks alone. By using both jacks and cables it was possible to obtain a movement which measured on the arc traveled by the farthest front corner of the building amounted to 10 to 17 feet per day. The total distance at this point traveled on the turn was 224 feet, and this was covered between October 23 and November 12, or seventeen working days. The building turn is illustrated in Figures 6 to 14.

As a result of the careful preparations in the track layout and guiding lines, the building in moving never varied more than about one inch from the predetermined path. This variation when it occurred was immediately corrected by changing the angle of the rollers slightly either in setting them as they were fed under the shoes or by tapping them with a hammer while they were under the shoes. During the last few feet of travel, the building was steered over the guiding lines with extreme accuracy to the exact position desired.

The smoothly applied forces and the slow, easy motion of the building could not be felt by the occupants and was imperceptible to the eye. The only way it could be detected was to line up some object and check the relative change in position from time to time during the day. Even with the rollers, the movement was so gradual that it could be realized only after a close-up inspection of them.

No damage to the building, even of a minor nature, resulted from the move and the structure was in the same sound condition at the end as it was before the move started. A few small cracks in interior partitions appeared as the columns were lifted in groups during jacking operations, but these as a general thing closed up as the whole building was brought back to an even bearing. During the rolling operation there was no apparent change in the condition of these cracks.

Unloading of Building from Rollers

With the building in its final position on the lot, the reverse of the original procedure of jacking up groups of columns was followed progressively until the building had been lowered to its permanent foundations. This last operation, involving the preparation of the new column bases and the lowering of the structure, required about a month to complete.

Certain columns which will be adjacent to the new structure are now being underpinned to the new building subgrade, and this work, together with the restoration of the walls and house

service equipment in the basement, is expected to be entirely completed in February.

Engineering and Contracting Personnel

The work was planned under the direction of the Engineering Department of the Indiana Bell Telephone Company in cooperation with the Operation and Engineering Department of the American Telephone and Telegraph Company. Vonnegut, Bohn and Mueller, Indianapolis, were the architects. The consultants were Voorhees, Gmelin and Walker, Architects; Moran and Proctor, Consulting Engineers, for foundations; H. G. Balcom, Consulting Engineer, for the structural steel design, all of New York, and Bevington-Williams, Inc., Indianapolis, Consulting Engineers, for the mechanical and electrical services.

The general contractor was Leslie Colvin of Indianapolis. The contractor for moving was John Eichleay, Jr., Company of Pittsburgh.

Because of the weight and size of the structure and due to the restricted area available for turning, together with the necessity of continuing normal operations within the building—including the regular business office activities with the public and uninterrupted maintenance of telephone service—this project introduced many problems new to the building moving art.

The wholly successful result—accomplished without even a minor mishap—is clear evidence of the ingenuity and precision with which the plans were conceived and made and of the skill and orderliness with which all the operations were carried out.

Vance Oathout
W. H. Harrison

The Methods of Industrial and Business Forecasting

Extract from Paper Presented at Dedication of the James Ward Packard Laboratory of Electrical and Mechanical Engineering, Lehigh University, October 17, 1930.

ONE approach to the matter of business forecasting methodology is through a consideration of the source from which the universal need for such forecasting arises. Why is it that business forecasting is so unavoidable? The answer to this question is, happily, a simple one. Forecasting is necessary because the modern economic system with its related social order is highly dynamic in character. What we usually call the economic machine is, in effect, a living organism which has much in common with the characteristics of living organisms in the animal and vegetable kingdoms. Conditions in the sphere of economic life are constantly in a state of flux. Change is ever in progress in markets, in sources of supply, in prices, in business organization, in methods of production and distribution, in habits of consumption—to name only a few of the elements of economic existence which every business man recognizes. And behind the outward and visible change in such elements as these, a process of modification is continually taking place in economic relationships, in ethical standards, in political beliefs, in social customs, morals, and ideals, and in all those fundamental and frequently intangible forces which wield an influence over the destinies of the human race and all its institutions. Moreover, these changes do not occur in a steady uniform flow. On the contrary, they come and go, they vary in intensity and in radius; they may be continuous, discontinuous, or periodic. In the case of any business institution, the objective of forecasting is to discern these prospective

changes, to appraise their probable importance, and to translate them into estimates, plans and policies relating to the future operations of the particular enterprise.

The Nature of Forecasting

Many persons seem to regard business forecasting as a species of black magic. As a matter of fact, of course, the processes of business forecasting are in no way mysterious. But it is true that these processes cannot be reduced to any rigid formula or series of formulas which can be expounded in fairly concrete terms. Unfortunately, forecasting in the business world may still be more of an art than a science. Moreover, the forecasting needs of some enterprises are radically different from those of others. In the case of many merchandising establishments, for example, the prime need is for short term forecasts covering the period required for a single turn-over of their stocks, whereas in other lines of business the emphasis naturally falls upon forecasts covering far longer periods. Accordingly, forecasting methods which may be appropriate and adequate for some enterprises may be wholly unsuitable for others. These methods tend to vary from industry to industry and from concern to concern, depending upon the character of the industry and the position of the individual concern within the industry. The methods actually employed must be closely adapted to the particular needs of particular organizations. In short, while the need for business forecasting is universal, the methods involved in such forecasting are almost infinitely varied and should never be purely mechanistic.

Under this set of conditions, the present discussion must be confined to methods applicable to the forecasting work of the larger industrial and business organizations; and it can do no more than suggest the general character of these methods. These suggestions, however, will be derived from the actual experience of an organization which does not have merely a hypothetical existence. This organization is the American

Telephone and Telegraph Company and its associated companies which together comprise the Bell System. Moreover, the nature of the telephone business is such that its experience in the field of forecasting has necessarily been exceptionally wide and, perhaps, exceptionally significant. As a business whose assets consist almost wholly of fixed and immobile property which does not "turn over" in the ordinary commercial sense of the term, long term forecasts are vital to the determination of the quantity, type and location of plant and equipment required to anticipate future demands for service in the most economical manner. As a business which touches the economic processes of the nation at every point, forecasts of the probable fluctuations in economic activity over short periods in advance are helpful aids to the preparation of short term budgets and operating programs. Finally, as an institution devoted to public service and intimately associated with the social life of the people, the Bell System must anticipate in its policies social as well as economic changes, both temporary and permanent.

As we see it, there are two classes of business forecasting: long term and short term. The line of demarcation between the two classes may not be especially well defined; and of course the differentiation between them will tend to vary among different types of business enterprises. But we are disposed to establish the distinction because the specific objectives of each class, and the methods required to meet these objectives, are essentially different from those of the other. In general, long term forecasting may be described as comprising those processes of intelligent prevision which are necessary, first, for reaching sound conclusions in respect of such matters as the fundamental rational status of the industry in economic society and the average level, or rate of growth, of business volume which is consistent with that status; and, second, for the development of progressive business policies which are in tune with prospective economic and social trends. Short term forecasting,

on the other hand, comprises those processes which are necessary for the determination and measurement of the prospective changes in economic and social behavior which are likely to be ephemeral in character, and for the formulation of those temporary plans and practices best adapted to adjusting the particular business to these transitory conditions. Even more briefly, long term forecasting is concerned primarily with the persistent trends of economic and social progress and with the associated long term planning of business concerns; while short term forecasting is concerned primarily with seasonal fluctuations and with the more or less periodic and rhythmic, semi-rhythmic or quasi-rhythmic deviations of economic and social phenomena around their lines of seculiar trend. These observations, I realize, are far from profound. I have ventured to present them, however, because it is apparent that great confusion exists in the public mind as to both the scope and the nature of those excursions into the realm of the unknown to which the term "business forecasting" has recently been applied.

Long Term Forecasting

In discussions of forecasting, its objectives and its methods, the emphasis is usually laid upon the class of short term predictions and estimates, almost to the exclusion of consideration of long term forecasts. I intend to violate this tradition by stressing the value of the longer look ahead. In my judgment, the accurate forecasting of basic economic and social trends is of vital importance to sustained progress on the part of business organizations; for constant vigilance must be exercised in order that fundamental business policies may be progressively modified to accord with the spirit motivating those trends which are persistently, though perhaps unobtrusively, tending to refashion the structure and the character of contemporary civilization. Business men generally should recognize that the present economic regime, even though it has produced the

greatest advance in material welfare in the history of the world, is still far short of perfection; indeed, it may not permanently survive unless business leaders are sensitive to basic trends in the economic concepts and in the social aspirations of our people. The tides of human behavior are just as important as the waves of passing fancy; and the two should not be confused.

There are two methods of approach to the problem of long term forecasting. Purely for purposes of present convenience, one of these methods may be called the quantitative, or statistical, method; the other, the qualitative, or philosophical, method. The two are not independent or alternative methods, however; on the contrary, they are distinctly complementary —so much so that it may safely be said that united they stand, divided they fall. In fact, while investigations along the two lines of approach have long been carried on simultaneously, it has only been since there has been collaboration between the mathematical statistician and the realistic economist that rapid progress has been made in the development of an adequate foundation for forecasting procedure.

The essence of the quantitative or statistical method is the collection of significant periodic, usually annual, data descriptive of various pertinent elements of economic life over a reasonably long term of years in the past; and the application to these data of statistical methods of analysis which will yield a quantitative measure of their characteristic behavior as to growth or decline. In other words, after ascertaining those series of economic and social statistics which are most significant and useful for the purposes of the particular forecast, the secular trends of these series are determined. These trends, it is clear, will reflect the net effect upon the series of the interplay of economic and social forces up to the current date. Under this method a forecast of the probable future trend of any series may be made merely by a simple projection of its current trend line. Through the application of the same statistical processes, the trends of elements within any particular business concern

(such as volume of sales) may be statistically described and measured, the degree of correspondence with the trends of external economic factors may be discovered, and current trends may be projected with due recognition of any pertinent relationships which have existed between internal and external data.

The question of the extent to which this method can profitably be employed by any particular business organization in the analysis of the trends of economic factors and of internal operations for forecasting purposes is, of course, one which can be decided only in the light of the type and character of the organization. The general question, however, is competently discussed in the bountiful crop of statistical textbooks which have matured in recent years; and these texts also explain the details of the statistical processes which this method embodies. It is not my purpose to compete with these excellent texts. But it may be appropriate to call attention, parenthetically, to the fact that practical experience shows a reasonable knowledge of statistical technique to be an essential part of the equipment of the potential forecaster in any line of business.

It is obvious that any objective extension into the future of current trends, no matter how carefully these trends may have been measured, will be fully significant only if the forces which have affected them remain unchanged in number and in relative intensity. The statistical approach might be adequate in itself under static conditions. But in a dynamic society the forces of development and progress do not remain unchanged. This provides the cue for the entrance of the philosophical method as a means of interpreting the statistical measurements and of furnishing qualitative descriptions of the changing currents in the economic stream.

This method presupposes in the forecaster a reasonable degree of understanding of the complex structure of the current economic and social order, and an insatiable curiosity to discover logical explanations for the action and interaction of the

many forces and groups of forces constantly at work to produce change. It assumes an innate flair for the detection of those undercurrents in economic behavior which are not visible on the statistical surface of the stream, and a keen sensing of the advent and the potentialities of new forces as yet in embryonic stage. Under the method, economic processes are continually under quasi-microscopic observation; and the observer must be alive to the silent but relentless evolution in popular tastes, habits, ideals and objectives which is characteristic of a progressive people and an advancing civilization. Cultural values, as well as economic values, must be appraised. In a word, the philosophical method provides the means whereby the projection of statistically-determined trends may be tempered and modified to allow for the probable influence of factors and forces which cannot be statistically described or measured. The fact that the probable effects of such forces are not expressible in quantitative form in no way lessens the need for their consideration. Indeed, a proper recognition of the existence of these intangibles and semi-intangibles is essential in the formulation of policies and in the provision of sufficient flexibility in the long term plans of business organizations.

The importance in business forecasting of an informed appreciation of the character of economic processes and a high degree of sensitivity to the significance of economic movements is not, in my opinion, adequately emphasized in the ordinary textbook which gives reluctant attention to the subject. Consequently, it is perhaps not surprising to find the existence of a fairly widespread belief that forecasting methods can be expressed in mathematical terms. I am firmly convinced that one cannot learn all about the future merely by turning the crank of a computing machine. There is no mathematical substitute for sound economic judgment based upon economic knowledge and economic intelligence. It is through the exercise of powers of philosophical reasoning, rather than through the concoction of ingenious mathematical equations, that Amer-

ican business management must adjust its fundamental policies, whenever necessary, to keep pace with the progress of a developing civilization reflecting the popular conception of economic, as well as political, democracy.

To my mind, a knowledge of those economic and social movements which have led up to our present economic structure and a thorough *understanding* of the significance of these movements, are exceedingly helpful in providing a background against which the significance and the potentialities of contemporaneous movements may better be assessed. I am not one of those who adhere to the belief that history is meaningless. On the contrary, I have no hesitation in entering upon the record a few words of modest praise of the study of the economic and social history of older communities and of the more modern business annals from the time, in the 15th and 16th centuries in western Europe, when business began to assume a position of dominance in the direction of the course of civilization,—a position which has grown stronger as the centuries have rolled by. In those days business men still constituted only a small minority of a population which was overwhelmingly agricultural; but by the time the first settlers came to America, the upward surge of the commercial revolution had already delineated the fundamental elements of a complex "money economy" or "business economy" in which the economic motives of the community are dominated by the making and spending of money. The succeeding development of this economic system is not only a fascinating study, but one which is useful to the business forecaster. History still deserves an honored place in educational curricula.

Short Term Forecasting

The problem of short term forecasting has received more public attention than has the problem of long term forecasting. This situation is primarily due, I suspect, to the fact that the short term outlook is usually a matter of immediate and often

of pressing importance, whereas speculation as to the long term trend of business can always be deferred until tomorrow and may not be needed at all in certain types of mercantile enterprises. If month after month and year after year, business invariably advanced steadily and uniformly along a measurable line of secular trend, a forecast of this trend would serve all purposes. But unfortunately for the forecaster among others, business progress is characterized by recurrent periods of accelerated and retarded growth. These alternating periods constitute that sector of economic dynamics which has come to be known as the "business cycle." In certain circles controversies may rage over the suitability of this term. But the business man is wholly indifferent to the niceties of nomenclature. He merely knows that no matter how stable his business may be, it will undoubtedly experience some degree of quasi-rhythmic fluctuations; and he wants reasonable advance notice of these movements—even though he may not act upon this notice when he receives it. I assume that we, likewise, are not interested in questions of terminology on this occasion. What we want to consider is the major question of how these cyclical fluctuations can be forecasted and anticipated.

Again I must be the bearer of bad tidings. There is no adequate mechanistic, rule-of-thumb, or lazy man's method of short term forecasting, if the subject is to be approached on anything like a scientific basis. As in the case of long term forecasting, there is need for statistical analysis and measurement on the one hand and economic interpretation and judgment on the other; but here the union between statistical processes and economic reasoning is so close and so indissoluble that they must be considered jointly in any discussion of the fundamental principles of methodology.

In these days of interdependent relationships in the business world, it may properly be assumed that any business organization, in appraising the near-term prospect for its own affairs, is first interested in forecasting the corresponding prospect for

business enterprises as a whole. To be most useful, this forecast should be expressed in quantitative terms, just as future long term trends must be expressed statistically. For practical purposes, it is usually not sufficient to know that the outlook is "good," "fair" or "poor," since such linguistic symbols as these are overly vague and each of them is broad enough to cover a fairly wide range of possibilities. One of the unfortunate characteristics of many forecasts is the fact that they are couched in language which is reminiscent of the utterances of the Delphic Oracle. What the business man wants is as definite a picture as possible of the "balance of probabilities." Qualifications may be necessary, but they should be presented so as to clarify rather than obscure the main theme.

As one prerequisite to short term forecasting, the forecaster must have at his command a quantitative and up-to-date statistical index appropriately representative of the relative monthly fluctuations of general business activity over a fairly long period in the past. The type of index I have in mind is so well-known that I believe no specific description is warranted. There are a number of such indexes available to the business man, such as those prepared by the Federal Reserve Board and by a number of independent statistical agencies. Some business organizations like our own, however, prefer to construct an index themselves, since they thereby have full knowledge of its ingredients, its character and its idiosyncracies. The statistical processes involved in the construction of such an index are fully explained in recent textbooks. Through the application of these processes, we obtain an index reflecting the relative monthly deviations of business activity around its secular trend, deviations due to purely seasonal causes having first been eliminated. That is, the index reflects those movements of business which are primarily cyclical in character; thus it gives the clearest possible picture of past cyclical movements and of the stage in the latest cyclical movement which has been reached by business as a whole at the time the fore-

caster must go to work. It likewise aids in the interpretation of the results of statistical analyses of the cyclical movements of those economic factors which must be considered individually rather than *en masse*.

Such an index also assists greatly in the study of the phenomenon of the business cycle and of the forces which generate it. The more the forecaster knows about these forces—their character, their relative importance and significance, their sequence, and so on—the better is he equipped to understand and to interpret the current business situation from a cyclical point of view. And I believe that we are making substantial progress in our knowledge of cyclical behavior. This progress, moreover, is not due to the fact that the cycle is a product of modern industrial organization. The cycle is not a new phenomenon in the economic world. Persistent students have uncovered a cyclical trail back into the 18th century; and economic archaeologists have discovered unmistakable traces of the beast as early as the 16th century. Indeed, the further back one follows the history of economic activity, the more precarious does existence seem to have been. Rather has our progress in cyclical knowledge been due to the fact that only comparatively recently has sufficient statistical material become available to make it possible to vivisect the phenomenon. While theories of causation are still numerous and diverse, nevertheless we are no longer ignorant of most of the vital facts as to the results of the motivating forces, whatever these forces may be. This certainly not only represents substantial progress, but gives hope of continued progress in the future.

Study of the past oscillations of business activity above and below its normal trend of growth shows beyond peradventure of doubt that these cyclical fluctuations, while definitely wavelike in their contours, do not exhibit a high degree of periodicity in the mechanistic sense of the term. Nor are they uniform in character. Business cycles are clearly governed by economic laws, not by the laws of mathematics. They occur as a result

of economic forces which themselves vary in intensity. Consequently, in forecasting cyclical movements of business it is absolutely essential to undertake a careful analysis of the relative importance of the particular forces in operation at the particular time. Knowledge of the current cyclical position, as determined by statistical measurements, is of immense assistance in this analysis. But a forecast of the future short term movement of any statistical index of business can be made only by the application of sound economic judgment based upon thorough analysis of all available pertinent facts bearing upon the probable influence of the various economic forces which are currently in operation. Here again, it may be remarked, the statistical procedure is indispensable as an aid to the analysis of individual economic factors and the study of their interrelationships.

The same general procedure is followed in making short term forecasts of elements within a particular business organization. First, the pertinent monthly data are statistically analyzed so as to isolate the movements therein which are cyclical in character. In order to determine the extent to which these movements are influenced by external factors, the cycles of the internal data are then compared with the cycles either in indexes reflecting business activity as a whole or in indexes reflecting certain lines of activity to which the particular business is especially sensitive. In view of the interdependence of business operations throughout the economic world, usually a degree of correspondence between internal and external cycles will be found which will permit a forecast of the prospective cyclical movement of the external index to be translated back into terms of the probable movement of the internal index. By applying this estimate of the cyclical movement to a projection of the trend and seasonal characteristics as previously determined in the statistical analysis, a forecast of the element in question is secured. This forecast may then be tempered, if

necessary, by application of special knowledge relating to the plans or the characteristics of the particular business.

Conclusion

I want to associate myself with those who believe that a scientific approach to problems of business forecasting will contribute its full quota to the achievement of that greater steadiness in economic progress which is so devoutly to be wished. Forward-looking industrial leaders are recognizing that opportunistic action on the part of business institutions merely for the sake of temporary competitive gain must more and more give way to systematic planning of reasoned programs. The business statesman must supplant the business politician, if order is to be maintained in a world in which the economic machinery is becoming more intricate and the economic processes more interdependent as time goes on. One of the most important qualities of the business statesman, perhaps the most important single quality, is intelligent foresight; and, after all, business forecasting is merely a process of rationalizing this foresight. Taking business as a whole, it is probably true, as some critics assert, that the effect of business forecasting upon overall economic stability has not yet reached substantial proportions, though some beneficial effects are already clearly visible. But it is also true that the science of business forecasting is still in its infancy. It is an upstart among the older sciences. By careful and sympathetic nurturing, can we not confidently expect that it will develop and expand in usefulness as have other sciences? I can see no sound reason for doubt on this point.

S. L. Andrew.

Toll Conduit Construction on Private Property

Preface

THE toll conduit between Albany and Catskill, New York, recently completed, was installed largely on private property. Prior to the construction of this project the use of underground conduit had been confined generally to highways and city streets. Because construction across private property introduces problems in design, construction and maintenance not met in work along highways, it is felt that a description of the experiences on this project will be of value in planning and building underground systems of a similar nature.

This account of the various steps in design and construction includes much data already available since existing standard designs and methods were adopted wherever practicable. The new features are described in more detail. Pictures of various pieces of equipment and operations on different parts of the work are included.

Subway Study

At the beginning of the year 1929, two aerial cables, the "A" and "B" cables, were in service between New York and Albany. A third, the "C" cable, was constructed aerially as far north as Catskill in 1929. Growth studies made in conjunction with the Long Lines Department indicated that the "C" cable would be required between Albany and Catskill in 1930, and that subsequent cables would be required at approximately two-year intervals. After comparing available types of construction, it was decided to construct underground conduit to provide for the "C" and subsequent cables from Catskill to Albany. The decision as to the type of construction

was based on the expected reduction of maintenance costs, the prospect of fewer service interruptions, and the right-of-way situation in this region. It was anticipated that if aerial construction were adopted, right-of-way would be difficult to acquire and would become increasingly so as each succeeding line was required. This situation was a very important factor in favor of underground construction.

Preliminary Route Survey

The general route follows the west side of the Hudson River valley through gently rolling country consisting largely of cultivated land and orchards with occasional small villages and hamlets. The soil is generally clay loam and clay, although the southern part of the project passes through considerable sedimentary rock which required blasting. At several points the line crosses swamps consisting of fine sand overlaid with muck.

Factors Affecting Selection

Preliminary trips over the proposed general route indicated that construction over private property rather than along existing highways was desirable. At the present time the only improved road along the route is rather circuitous and, in general, only 18 feet wide. The curves are frequently quite sharp. The Highway Department is planning to improve a route on the west side of the Hudson River similar to the high-speed highway recently completed on the east side, and major changes of line and grade were anticipated. At many places along the road rock is close to the surface, and substantial blasting operations would be required in connection with highway improvement work. It would be practically impossible to maintain a subway while highway construction operations were under way. Because of the present narrow road, construction of a subway in the shoulder would seriously interfere with traffic. Subsequent highway widening and realignment would

undoubtedly throw some of the manholes under the driving surface, which would create a dangerous situation when the manholes were open for any new construction or repairs.

Aside from the construction difficulties which would attend the selection of a highway route, there were other factors tending to throw the balance in favor of construction on private right-of-way. Construction along the highway would have subjected the cable to exposure to a 66 KV transmission line which parallels the road for about 16 miles, whereas it was possible to select a route on private right-of-way that reduced this exposure considerably. Also, this permitted the construction of the conduit in practically a direct line for its entire length, thus shortening the line by approximately three miles as compared to the shortest highway route. This, of course, represents a substantial saving in present worth for the plant contemplated during the period of study. Furthermore, this reduction in length was of added importance, inasmuch as it might otherwise have been necessary ultimately to build an additional repeater station.

Preliminary office studies of the route were made on a composite map of United States Geological Survey sheets showing the area through which the line would pass. A tentative line was laid out for study in the field and trips were made to check the desirability of this line, keeping in mind at all times that all points along the route had to be accessible to motor vehicle equipment.

Detailed Survey

Aerial Photographs

Aerial photographs were also used in the preliminary studies of the route and in the right-of-way negotiations. These photographs presented physical conditions in more detail than the U. S. G. S. maps and also indicated improvements which had been made since the maps were last revised. They showed

the objects which were to be avoided, fence and property lines, and the character of the land through which the proposed line was projected. At one point the photographs disclosed an abandoned railroad grade close to the proposed line. Investigation in the field showed that about five miles of this right-of-way was adapted to the requirements of the proposed line, and the tentative route was located to include this section.

The photographs, with the proposed line drawn upon them, proved of considerable value in later discussion. With their aid, property owners were shown how the line would cross their properties, and the important features of the route were pointed out to the surveyors. They also proved useful in condemnation proceedings.

Factors Affecting Location

The line was laid out with as few deviations from a straight line between the termini as was consistent with economical construction. However, various factors, physical and electrical, influenced the decision as to the best location. Exposure to potential electrical troubles caused the most important deviations. On the southern end of the project, the direct line route would have carried the subway parallel to a transmission line with very little separation between the two lines. Five miles of the tentative line was relocated to reduce this exposure. At other points along the line minor deviations were caused by the estimated inductive effects of proposed power lines and the possible electrification of a paralleling railroad.

There were many physical features which caused minor bends in the line. Some of these were natural, such as streams, swamps, rock and steep banks, and some were man-made, such as railroads, highways, and buildings. Crossings under railroad tracks were made approximately at right angles to the tracks. Streams and ravines were crossed on existing bridges or at sites where it was economical to build new structures. Swamps and rock were avoided wherever it was possible to do

so with a slight relocation of the line. Steep banks, were crossed at points suitable for building and maintaining the duct line.

Ultimate Line of Subway

The final line consisted of about 8 miles of construction in city streets and along highways and 24 miles of construction on private property. The total length of the conduit line is approximately two and one quarter miles more than the airline distance between the cable vault at the central office in Albany and the cable house at Catskill, the termini of the project.

Right-of-Way Negotiations

Permits

Construction on private property required extensive right-of-way negotiations. Beside the actual right-of-way it was necessary to obtain various easements, permits for surveying, rental of storage space for materials, rights of entry to the conduit line through the various parcels, and permits for construction in state, town, city and village roads and streets, and for crossing railroads and attaching to existing bridges.

Right-of-Way

The right-of-way acquired consisted in a permanent easement to construct and maintain the various features necessary for the telephone project, the company being restricted to the uses mentioned. All other uses, not inconsistent with the rights granted to the company, were reserved to the owner. Rights were acquired for construction along highways where the fee to the center of the road was retained by the abutting property owner.

On private property the conduit line was laid along the center of a 20 foot right-of-way, the space on the sides being used for construction operations and to provide for future re-

inforcement. This width was sufficient when construction equipment could be driven over adjoining land but was too restricted when the use of equipment was confined to the area between the right-of-way lines, as it was in all cases where the property was condemned. A strip 25 or even 30 feet wide probably could have been secured for the same price as the 20 foot strip, as the major factor in determining the value of the strip was the effect of the presence of the easement on the salability of the property.

Rights of Entry

Rights of entry were secured along an existing traveled way or along a route suitable for trucking designated by the property owner. They generally cost about half as much per lineal foot as the right-of-way parcel which they served.

Condemnation

The preparation of petitions in condemnation required that title searches and surveys be made for every parcel involved. The searches were necessary to determine the parties having interest in the property, so that they could be included in the suit. The survey was required so that a plan could be prepared showing the crossing of the proposed line and the proposed route of entry. Detailed plans of the various construction features had to be included in the petition also. The preparation of the engineering features of each case required about three days work by two men. Progress reports were kept, showing the right-of-way acquired, on the basis of lineal feet of right-of-way, and the method of acquisition.

Duct Construction

Start of Work

Work in the city of Albany was started on July 29. Construction work on the rest of the project was started shortly

thereafter. Working conditions on the rural sections were such that mechanical equipment could be used on about three fourths of the excavating and backfilling. In all, five trenching machines, five mechanical backfillers, and three types of excavators were used.

Duct Work

With the exception of two cases of special bridge attachments and one case of steel pipe placed on a steep bank, all described in detail later, vitrified clay conduit was used throughout the project. The tile was hauled by truck to practically every point on the line, the loads being reduced when the hauling was too hard. Only standard lengths were hauled and stocked in the rural sections, the short and special pieces being secured when required. The other materials used in the duct work were standard, with the exception of the forms and covers used in making the joints.

Protection

Wherever soil conditions were favorable no top or bottom concrete protection was placed where a 2 foot cover was secured as it was felt that the danger from excavation was too slight to warrant the placing of protective concrete and a satisfactory bed could be secured without the use of a concrete base. However, concrete top and bottom protection was used through cities and villages and wherever the conduit line was within 100 feet of a highway. The concrete used was of 1:2½:5 mix and was kept rather dry (about 1 inch slump). At all points where less than 2 foot cover was secured, concrete top protection was used.

Special Construction

Swamp Crossings—Fills

Through swamps and across ravines, the conduit was generally placed upon fills made of suitable local material. The

decision as to whether the conduit would be placed underground or on a fill was affected by various considerations. The accessibility of the duct line and the assurance of positive drainage were the principal factors supporting construction on fills in most cases. Construction on fills was expensive because not only was the fill material required, but also forms had to be set and concrete protection poured around the conduit. Generally, some sort of drainage structure had to be built also, to carry the natural surface drainage through the fill. Where underground construction would have been as satisfactory, comparisons of costs of the different methods were made. At some points cost considerations were not a factor, as underground construction would not have been satisfactory because of the impossibility of draining the ducts.

The fills were made 10 feet wide across the top, with 1½:1 side slopes. Fills greater than 3 feet high required a wider right-of-way or a reduction of the top width. Both methods were used with satisfactory results. The fills were placed in thin layers and thoroughly compacted, as time was not available to allow them to settle. In two cases suitable local material was not available so screenings were secured from nearby quarries and used in the fills. This material is apparently satisfactory, but few of the fills have been subjected to erosion as yet, so no definite experience can be cited. The possibility of using trestle construction, consisting of a concrete slab resting on concrete piers was studied but it was found that this method would have been economical only where the height of fill exceeded four feet. This type of construction could have been adapted to crossing ravines but suitable footings might have been difficult to build in swamps.

Culverts

Vitrified clay pipe and concrete culverts were used to provide drainage through the fills, the type depending on the relative

FIGURE 1. Fill placed where route traverses swampy land.
FIGURE 2. Sewer pipe culvert under conduit on fill.
FIGURE 3. Concrete culvert under conduit on fill.
FIGURE 4. Manhole partially above ground (exterior view).
FIGURE 5. Manhole partially above ground (interior view).
FIGURE 6. Piers for conduit bridge.
FIGURE 7. Steelwork for conduit bridge.

FIGURE 8. Forms for concrete encasement of conduit bridge.
FIGURE 9. Conduit bridge completed.
FIGURE 10. Forms and reinforcing for encasement of conduit structure placed above ground.
FIGURE 11. Conduit structure on fill.
FIGURE 12. Conduit structure on fill, showing drainage culvert.
FIGURE 13. Manhole marker on private property.
FIGURE 14. Manhole marker at side of highway.

costs and the requirements of the site. No head walls were used on the pipe culverts as the height of the fill was generally low and it was cheaper to extend the pipe to the points where the slopes of the fill met the normal ground. Concrete culverts proved more economical than the larger sizes of pipe. The former were used for sites where a waterway greater than that afforded by a 24 inch pipe was required to carry a stream through a fill. Span lengths of 6, 8 and 10 feet were used depending on the location and waterway requirements. The design consisted of a reinforced concrete slab resting on two concrete abutments. The abutments were designed with wings to retain the fill. The conduit was laid on the slab with a mortar bed and encased in concrete. Footings were carried to a depth sufficient to avoid erosion and frost heave. Where the duct line drained to the culvert, weep holes were left in the slab to carry off the water. These functioned satisfactorily at normal temperatures, but during prolonged cold weather ice formed in the weep holes. This resulted in the water backing up in the ducts and subsequently freezing. To remedy this condition intercepting drains were installed in the banks on either side of the low spot. These drains consist of a stone pocket under an open joint in the tile. Where practicable, an 8 inch vitrified pipe is installed to drain from the pocket to an outlet.

Where manholes were required in sections where the conduit was laid on a fill, the design was modified to provide for pulling-in through the end of the manhole by constructing a pressed steel coal window in the ends above the ducts. Recesses were constructed in the end walls of the manholes. The manhole walls were carried through the fill to bearing on a substantial footing built in the original ground.

Conduit Bridges

At six points along the line where small streams had to be crossed, studies were made to determine the most satisfactory

method of crossing. The costs of wrought iron pipe, steel pipe encased in concrete and a concrete and steel trestle structure were studied and the concrete and steel structure seemed most economical and assured drainage of the duct line. Special conduit bridges were designed to carry the line across these streams. These structures were constructed of steel channels and angles encased in concrete for protection. Beside the dead load, the designs provided for a live load consisting of one cubic foot of ice per foot of span. The structures were so designed that the entire weight was supported by the steel, the only function of the concrete encasement being that of protection to the steelwork and duct, and affording also a somewhat more sightly structure. The bond between the spans and the piers and abutments was broken so that only vertical stresses could be transmitted to the supports. The normal section of tile conduit was carried through in each case. Span lengths varied from 10 to 40 feet.

Comparisons of costs were made for these and longer spans. On one structure, during the time between the design and the construction, the water level rose so that the span length required to keep the piers on dry land was increased from 42 to 55 feet. The possibility of building a longer span and keeping the piers on dry land was investigated but it was felt that constructing the shorter span with the piers in shallow water would be more economical. The designs of the long span structures required material which was not available locally. They were revised so that material from local shops could be used because steel deliveries in Albany were uncertain. These revisions consisted in riveting heavier angles on the channel beams and riveting plates on the vertical leg where angles were used for the beams. Longer spans would have required the use of built-up members involving special erecting equipment.

No particular trouble was encountered in building the special conduit bridges across the various streams. The structures were constructed eccentric on the right-of-way, the center line

of the structure generally being parallel to and five feet away from the center line of the right-of-way strip. The duct line was brought back to the center line on a long radius curve. The object of moving the structure away from the center line was to allow sufficient space for the construction of a temporary bridge beside the structure. (On a wider right-of-way this, of course, would not have been necessary.) Piers and abutments were constructed to the proper designs and elevations at each location. Where the heavier steel members were required, a gin pole was used in their erection. The steel members were trucked as close as possible to the bridge site and then dragged to the site by tractor. Forms for encasing the steel work and conduit with concrete were generally suspended from the steel beams. Encasement concrete was of 1:2:4 mix using one-half-inch stone to reduce the tendency for honeycombing to form. Care was required in tamping the concrete into the recesses under the channel flanges but the remainder of the concrete was easy to place. All exposed surfaces were floated with a wooden float immediately after stripping the forms, in order to remove form marks and rough places.

Drainage Provision

Drainage of the duct lines was provided for in laying the grade lines on the profiles. Subsequent changes in the manhole locations threw two low points in the duct line. A pumping sump consisting of a concrete box with 6 inch walls, floor and roof, was constructed at one of these points. The inside dimensions were 4 feet x 4 feet and it was carried to a depth of 1 foot below the bottom duct. It was equipped with a type "B" 27 inch manhole frame and cover, so that a man can get in and clean out any silt which might wash through the tile and be deposited in the hole. At another point, a stone drain and outlet pipe was placed at the low point in the duct line. Such conduit drains were used only where a positive outlet could be secured as it was felt that without positive drainage a rise in the

water table would cause water to flow from the drain into the duct line.

Complete Encasement

Where there was less than 1 foot cover, or where the conduit was exposed, it was completely encased in concrete. This encasement consisted of a 4 inch concrete base and 3 inch sides and top. Where the conduit was in a trench, no forms were used for the encasement. When the conduit was even with the ground or on a fill a trench was dug for the concrete base and side forms were used. One-half inch reinforcing bars were placed in the base to prevent any local settlement of the fill from affecting the duct line. Wire mesh 6 inch x 6 inch x 14 gauge was also placed in the base and around the tile to help hold the encasement in position. A 1 inch chamfer strip along the top of the form was used to furnish a guide for smoothing off the top. This chamfer also decreased the possibility of spalling along the top edges. Concrete for the encasement was of 1:2:4 mix using ½ inch stone. The use of larger stone was tried but it was found too difficult to avoid honeycombing. The exposed surfaces were floated immediately after stripping the forms and defective places were patched.

Provision for expansion was made in most of the concrete encasement on conduit built above the ground. Two types of expansion joints, poured and premolded, were constructed and some short sections of encasement were constructed without joints. Cracks about 30 feet apart have appeared in the latter sections but, as the cracks are small, no serious trouble is anticipated. In both cases where joints were provided they were made only in the concrete encasement, it being felt that, if sufficient stress develops, the bond between the concrete and the section of tile spanning the joint will be broken and the expansion joint will function. Three-quarter-inch premolded expansion material was used for one set of joints. This material was placed to form a transverse joint through the con-

crete every 30 feet. In the case of the poured joints, wooden bulkheads 1 inch thick were placed in the concrete 30 feet apart. These were pulled after the concrete had set, leaving a break in the encasement. These spaces were then filled with bituminous mastic joint filler.

Manholes

Designs

Manholes on the toll run are so designed that no cable will have to be moved after splicing. This feature seemed so desirable that a study of the possibility of splaying the ducts entering the manholes was made soon after the work was begun. The results indicated that because of the special features involved in the construction of this project the costs of splaying would be abnormally high and that the operations would proggress much more slowly. In view of this, no splaying was used. The racks are set out from the wall to permit the splicer to make the splice without moving the cable out from the wall. Also, the cables are to be racked on 12 inch centers.

Loading Manhole Excavation

Loading manhole excavation was done by machine. In most cases the holes were carried to a depth of about 15 feet. Sheeting was used on all of them. A three-fourth-yard excavator, equipped as a clam shell, was used on the northern end of the job. The machine dug the center of the hole and hoisted the material removed from the sides. In the city of Albany it was emptied directly into trucks so that double handling was avoided. Material around the sides of the hole had to be removed by hand, and shovelled to a position where the bucket could reach it. A three-eighths-yard crane was used on one contract and a small shovel equipped as a trench hoe on another. These machines were better adapted to the work than the clam shell because of their smaller size and greater ease of handling.

Line Manhole Excavation

Line manhold excavation was done by hand throughout the job as the holes were not big enough to allow a machine to operate. The trenching machine was used to dig a few manholes, but because of the demand for it in opening trenches, it was available for manhole work only a small part of the time. Sheeting was not, in general, required on these manholes but shoring was used on about one-half of them.

Pouring

Two systems of pouring manholes were used. On the two northern contracts mixers were set up at central points and the mixed concrete was hauled to the manhole sites. On the two southern contracts mixers were set up at each manhole site. The use of the central mixing plant was very convenient in the city work as it reduced the amount of street space necessary for the construction operations. The setup in the city was used for all the work on this contract and about three miles on the northern end of the next contract. One other setup was used to complete the remainder of the second section. The maximum haul was about six miles, most of this being over improved roads. The concrete and mortar were generally hauled in special trucks consisting of hopper bodies mounted on Ford chassis. Mortar was not seriously affected by the haul but segregation appeared in the concrete, especially in the wetter mixes. This was corrected to some extent by dumping the trucks into a receiving hopper and shoveling from the hopper into the forms. The concrete was remixed by hand where the segregation was too great. Some type of agitation would have been preferable for use on the extreme hauls over rough roads. Extreme segregation occurred in only a few cases but remixing by hand gave fairly satisfactory results.

Marking

One concrete marker was set along the side of the manhole opposite the manhole cover at all manholes on private property. This marker was set with one face parallel to the side of the manhole and with about three feet exposed. The manholes were numbered consecutively from Albany to Catskill with an additional serial number for each loading manhole, the pulling-in of the cable being started at the Albany end with cable reels numbered in the order in which they would be placed. The manhole numbers were stenciled on the concrete markers with standard black stencil paint using 2½ inch stencils. Where the conduit was laid under the shoulder of a highway, one marker was set on the right-of-way line of the highway opposite the head. Numbers for manholes in these locations were stenciled on this marker. On the manholes under streets the number was stenciled on the side of the roof opening under the cast iron frame.

Equipping

Manhole frames were drilled and two anchor bolts, set in the roof of the manholes, were used to hold the frames in place during pulling-in. The anchor bolts were omitted in manholes in the city where covers would be secured by sidewalks or pavements. Where manhole heads were located in highway shoulders close to the pavement a concrete ramp was constructed to prevent erosion of the surrounding soil from leaving the head extending above the surface. These ramps consisted of a 5 inch concrete slab with one edge level with the edge of the highway and the other edges curved down beneath the surface of the shoulder. A mason and helper, following the gang stripping forms, laid the collars and set and bolted the frames in place. The racks, loading manhole decks and manhole markers were set in connection with rodding the ducts, to reduce the number of times the manholes had to be pumped out.

Winter Construction

Construction work on the project continued until the end of January and cold weather proved a serious drawback to the work. The frozen ground was much easier to haul over than the mud but this advantage was not appreciable as most of the trucking had been done earlier in the season. The tile froze to the ground, both in the storage yard and along the job. When pried loose, clots of frozen mud stuck to the sides and had to be chipped off. Motor equipment was hard to start on cold mornings and many small delays were caused by the inability to start the trenching machine or trucks. With 15 inches to 18 inches of frost in the ground the trencher would not handle the excavation. Unslaked lime was spread along the trench about 2 inches thick and covered with straw. In slaking, the lime developed enough heat to draw the frost from the ground for 6 inches to 8 inches and the trencher was able to handle the rest of the frozen ground. Heavy sod and the cinder ballast on the railroad grade prevented the frost from penetrating as deeply as it did in open fields. A compressor or steam jet probably would have been required had the ground been frozen to a depth of as much as two feet.

Concreting operations were made more difficult by the cold weather and greater care was required to secure a good job. The aggregates were heated by fires built in cans in the stock piles. These were not very efficient in heating the aggregates but prevented lumps of frozen sand from getting into the mixer. Mixing water was heated in all cases and admixtures either of salt or calcium chloride were used where the use of such admixtures was consistent with the purpose for which the concrete was used. Where the central mixing plant was used it was practically impossible to keep the concrete from freezing in the trucks on the haul to the job. Because of this, concreting operations were delayed until favorable weather. Less difficulty was encountered in keeping the mortar warm as the sand was

easier to heat than the stone for the concrete. The steel joint forms were heated and the joints were covered as soon as possible after pouring. Back-filling was done the same day that the trenching was done because the spoil banks froze so solidly over night that the back-filler would not handle the material without its being broken up with picks. Several small fills had to be made when the ground was frozen. As it was planned to lay the duct immediately after the fill was completed unfrozen earth was used so it could be compacted. The frozen crust was stripped from a borrow pit and the material beneath was placed in the fill as quickly as possible. The tractor treads collected mud which froze and rubbed on the guards and body of the tractor and had to be chipped off several times each day.

The labor cost of winter construction was about one-third greater than that of work done in the summer and, even with this additional cost, the job was not as satisfactory as fills could not be compacted satisfactorily and concreting operations had to await warmer weather. In this part of the country, therefore, such a job should be scheduled for completion not later than early December, if possible.

Conclusions

Construction on this project is now completed and the first cable, of 2⅝ inch diameter, was installed and placed in service on May 1. Having reached this point, those intimately in contact with the progress of the work on the entire project are quite in accord in the opinion that in localities where the available highway routes are unfavorable from various standpoints, a private right-of-way route will frequently afford an attractive alternative. Elimination of interference from traffic, particularly where high speed through highways would offer the only alternative route, is, of course, a feature worthy of consideration. Also, it was possible to take advantage of the flexibility the selected route afforded in avoiding the natural

and man-made obstacles which would have presented themselves had the conduit followed a highway.

It is true that the selection of the route followed introduced some new problems, but they were of minor importance in comparison with those which were avoided. Furthermore, the experience gained on this project will be invaluable in anticipating and providing for these new features when they are encountered on future projects. In view of the above, when new conduit routes through similar territory are contemplated, careful consideration will be given to the possible use of a route over private right-of-way as against construction on an existing highway.

G. P. DUNN
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Overseas Telephone Extensions During the Past Year

IN a letter written in 1878, the early dawn of telephone development, Dr. Alexander Graham Bell foresaw that "A man in one part of the country may communicate by word of mouth with another in a distant place." Few prophecies, so daring for their time, have been so completely fulfilled, both in the letter and in the spirit.

On January 1, 1931, 91 per cent, or 32,200,000, of the 35,300,000 telephones in the world were within conversational distance of any Bell System instrument. Additional arrangements for international telephone connections during the year 1930 were responsible for 2,200,000 of these telephones, distributed among fifteen nations, seven of which previously had been without telephone contact with this country. These 2,200,000 telephones were distributed also among four continents, two of which, namely, South America and Australia, had been without such contact. The countries and districts served by these newly connected telephones have an estimated population of 92,000,000, which, together with the population served by the Bell System and its previously established connections, makes a total of some 450,000,000 people, or 23 per cent of the world's population, to whom Bell System service is now available.

The expansion of international telephony during 1930 is briefly summarized as follows:

During 1930 radio-telephone service was established between the United States and two continents in the Southern Hemisphere. The telephones of Argentina, Chile and Uruguay in South America were linked with this country by means of a radio station at Buenos Aires, and the eastern portion of Australia, including the city of Adelaide, has been connected

via London. In addition to the slightly more than one-third of Mexican telephones previously reached, the remaining two-thirds have been connected. In Europe, telephone service with the United States was established for the first time with Finland, eight cities in Poland, and two cities in Lithuania. The international service which had been established previously was extended from Paris and certain other points in France to include all of France; from Copenhagen to include all of Denmark; from Budapest to include all of Hungary; from Oslo to include all of Norway; from Luxemburg City to include all of the Duchy of Luxemburg; from three Swedish cities to include all of Sweden; from three Italian cities to include all of Northern Italy, Rome and Vatican City, or approximately 75 per cent of the Italian telephones.

In the realm of mobile radio-telephony, five ocean liners are in contact with the Bell System telephones. In addition to the service instituted with the *Leviathan* on December 8, 1929, radio-telephone service was established during 1930 with three other transatlantic liners, namely, the *Majestic, Olympic* and *Homeric,* and with the steamship *Belgenland* now on a round-the-world cruise.

There are very few of the larger countries of the world not now connected with the United States telephonically. For instance, of the countries not now accessible by telephone from the United States, only five, namely, Japan, Brazil, New Zealand, Russia, and China have more telephones than the city of Baltimore, Md.

With the establishment of the radio telephone station now under construction on the Pacific Coast, service will be given between the United States and Hawaii, and this station will be capable of providing telephone service across the Pacific to Japan and other Far Eastern countries. The establishment of service to such countries will necessarily await the construction of radio telephone stations there. The present indications are

that if economic conditions and demand develop normally, service to countries such as Japan is not far in the future.

Those radio telephone facilities in the United States now serving three countries in South America will undoubtedly be expanded to provide service to additional South American countries in the near future. It is probable, therefore, that within a relatively short span of time the only larger nations of the world not connected with the United States will be China and Russia. The vast size of these countries is disproportionate to their telephone development and it may be some time before the economic conditions there will justify the establishment of telephone service with the United States.

When a goal is reached a new one must be visualized. The Bell System has more than fulfilled Dr. Bell's early prophecy. In the next few years we may expect connection with a majority of the remaining nine per cent of the world's telephones with which Bell System service is not yet available. After that international telephone extension must be interdependent with the world's advances in civilization, economic development, and more complete understanding. That is to say, that while there is no necessity for telephone contact with undeveloped regions, existing and possible international telephone circuits may well become a powerful factor in extending the boundaries of civilization.

Notes on Recent Occurrences

SCOPE OF OVERSEAS AND SHIP–TO–SHORE TELEPHONE SERVICE FURTHER EXTENDED

Australia

REGULAR commercial telephone service was inaugurated by the American Telephone and Telegraph Company between North America and Australia on Monday, October 27.

The circuit employed in this service is by far the longest ever established for regular commercial telephony. It consists principally of two radio links, one across the Atlantic and the other between England and Australia. With the wire lines involved in the connection, the circuit between New York and Sydney, Australia, is more than 14,000 miles long.

The service covers the States of Queensland, New South Wales, and Victoria and the City of Adelaide. This adds nearly half a million telephones, serving a population of some five and a half million, to the network within the reach of Bell System stations.

The Australian service was arranged by the American Telephone and Telegraph Company in co-operation with the British and Australian Post Offices and the Amalgamated Wireless Company of Australia. The circuits across the Atlantic are the same as those employed in the telephone service connecting North America with England and the Continent. The England-Australia link is operated by stations near London and Sydney, which established commercial service between the two countries last April.

The cost of a call between New York and any Australian point is $45 for the first three minutes, and $15 for each additional minute. For calls involving more distant points in

North America, an additional charge is made, corresponding to the present zone charge for the transatlantic service.

Among conversations passing between the United States and Australia on the day after the service was opened was the longest commercial call on record. It covered a total distance estimated at 21,000 miles terminating at Los Angeles, Calif. and Sydney, Australia.

Due to the eighteen-hour time difference between the two points, the speaker in Australia talked at about one o'clock, Wednesday morning, while his words reached the listener in Los Angeles, approximately a fraction of a second later, at 7:00 a.m. Tuesday. Following the usual route of conversations over the new speech channel, the call went from a Sydney telephone to the local radio station. There it was amplified and sent to London where it was received, switched to one of the regular transatlantic circuits and forwarded to New York to the American Telephone and Telegraph Company's receiving station at Houlton, Me. It then passed over the regular long distance land lines to Los Angeles.

The novel feature of this call is the unusual path it followed. As a result of extended tests at the Australian and British radio stations it has been found that transmission in daylight is much better than at night. To take full advantage of this, the radio stations in England and Australia have, therefore, been set up to transmit either directly at each other or around the other side of the world,—for example, from London southwestward across South America and the Pacific to Sydney. This adds about 4,000 miles to the total distance.

South America

All points in Argentina, Chile and Uruguay having telephone connection with Buenos Aires are now within reach of Bell System telephones. This is in consequence of an extension, effective January 1, 1931, of the telephone service from the United States to these three countries, operating through the New

Jersey radio stations of the American Telephone and Telegraph Company, and the Argentine stations of the International Telephone and Telegraph Corporation. Previously the service was limited to Argentina, nine cities of Chile and the city of Montevideo, Uruguay.

Canada and Mexico

A similar extension became effective on that date in the Canadian and Mexican territory connected by telephone with Europe and South America. Practically all telephones in Canada and Mexico now come within the scope of the service. Formerly the overseas talking range was confined to the Eastern part of Canada, a few cities in Western Canada and a dozen cities in Mexico. Transatlantic telephone service to Canada and Mexico is handled over the four radio-telephone channels linking the A. T. and T. Company's stations with those of the British Post Office in England and Scotland.

Europe

Within the past few months, transatlantic telephone service abroad has been extended generally to practically all parts of Western and Middle European countries in which the service was previously available to only one or two cities.

Service Planned to Bermuda

Application has been made by the American Telephone and Telegraph Company to the Federal Radio Commission for a construction permit to erect stations for a short wave radio telephone service between the United States and the Bermuda Islands. The Company contemplates a service that will provide voice communication between the Bermudas and all the United States. In Bermuda the service will be handled by the Imperial & International Communications, Ltd., working in conjunction with the Bermuda Telephone Company.

The plans call for the construction of a transmitting station

at Lawrenceville, N. J., adjacent to the short wave transmitters now used in the telephone service to Europe and South America.

The receiving station will be located at Netcong, N. J., the site of the short wave receivers for the European and South American telephone systems.

The Bermuda Islands are approximately 800 miles from New York. While the population is small, since the entire group lies within a 22-mile circle, the islands are visited annually by thousands of Americans on vacation, and the number is increasing each year. The proposed direct voice channel will enable these visitors to keep in close touch with affairs at home.

The transmitting and receiving stations of the Imperial & International Communications, Ltd., will be located in the vicinity of St. George's and Hamilton, respectively, where connection to the island telephone system will be made.

Ship-to-Shore Service

When the steamship *Belgenland* of the Red Star Line left Antwerp for New York on December 2 to begin her round-the-world cruise, she was equipped with a radio telephone system similar to that which has been in service on several other large vessels. Regular ship-to-shore telephone service through the American Telephone and Telegraph Company's New Jersey radio telephone stations linked the liner with this country while she was in the North Atlantic, and will be in service on the rest of her voyage around the globe as long as effective talking is found possible. Similar telephone connections will be maintained with Europe through short wave radio telephone stations in England, and with South America through the Argentine stations of the International Telephone and Telegraph Corporation. This service will be largely experimental to determine the extent to which ship-to-shore telephone service may be extended to areas outside of the North Atlantic. Ship-to-shore telephone equipment on the *Belgenland* is owned and op-

erated by the International Marine Radio Company, a subsidiary of the International Telephone and Telegraph Corporation. This globe-circling voyage will be the first of such extensive voyages during which telephone service has been attempted.

Permission to erect a radio station to be used for radio-telephone communication between water craft operating in New York Harbor and vicinity and the land telephones of the Bell System is sought in an application which has been filed with the Federal Radio Commission, through the Supervisor of Radio of the United States Department of Commerce in New York, by the New York Telephone Company. The New York Telephone Company contemplates the introduction of this new type of ship-to-shore service within the next year.

The Pacific Telephone and Telegraph Company and the Southern California Telephone Company recently filed applications for construction permits for similar harbor telephone stations to be located in the vicinity of Seattle, San Francisco and Los Angeles.

HALE HOLDEN MADE A. T. & T. DIRECTOR

AT the meeting of the Directors of the American Telephone and Telegraph Company on December 17, Hale Holden, Chairman of the Executive Committee of the Southern Pacific Company, was elected a Director.

VICE–PRES. GHERARDI OF A. T. & T. CO. ELECTED PRESIDENT OF THE AMERICAN STANDARDS ASSOCIATION

BANCROFT GHERARDI, Vice-President and Chief Engineer of the American Telephone and Telegraph Company, was elected President of the American Standards Association at the annual meeting of the Association in New York on December 11.

Mr. Gherardi has been a member of the Association's Board of Directors for some time. As President he will assume direction of the standardization activities, national and international, in which more than 2,000 representatives of approximately 500 national trade, technical and governmental groups are engaged under the auspices of the American Standards Association.